### Classic experimental design

<table>
<thead>
<tr>
<th>Classic experimental design</th>
<th>Time</th>
<th>Pretest</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Experimental group</strong></td>
<td>R</td>
<td>O₁</td>
<td>X</td>
</tr>
<tr>
<td><strong>Control group</strong></td>
<td>R</td>
<td>O₃</td>
<td></td>
</tr>
</tbody>
</table>

#### Definitions

- R = random assignment
- O = observation
- X = experimental stimulus (= independent var)
- **Randomization** is particularly important: divides systematic biases between two groups
Decisions

- If $de > dc$, then + relationship
- If $de < dc$, then – relationship
- If $de = dc$, then no relationship

Pygmalion in the Classroom: Gains in IQ points, by grade

![Bar chart showing gains in IQ points by grade for control and experimental groups.](chart.png)
# Internal validity:
12 problems leading to internal invalidity

1) history  
2) maturation  
3) testing and retesting  
4) instrumentation  
5) statistical regression  
6) selection biases  
7) experimental mortality  
8) causal time order  
9) diffusion or imitation of treatments  
10) compensation  
11) compensatory rivalry  
12) demoralization

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## Internal validity

- Classic experimental design: guards against history, maturation, testing, instrumentation, statistical regression, selection bias, experimental mortality
- Rest (8-12) handled through careful administration of design (keep 2 groups separate)
External validity: problems in experiments

- **External validity**: can the results be generalized beyond experiment?
- Question: how representative is sample?
- Question: does the artificial nature of the experiment affect generalizability?

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**Solomon 4-group design**

<table>
<thead>
<tr>
<th>Solomon 4-group design</th>
<th>Time</th>
<th>Pretest</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental group I</td>
<td>R</td>
<td>$O_1$</td>
<td>$X$</td>
</tr>
<tr>
<td>Control group I</td>
<td>R</td>
<td>$O_3$</td>
<td></td>
</tr>
<tr>
<td>Experimental group II</td>
<td>R</td>
<td></td>
<td>$X$</td>
</tr>
<tr>
<td>Control group II</td>
<td>R</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Solomon 4-group design

- Does the pretest have an independent effect?
- Does pretest sensitize people so that posttest gives different response, over and above the effect of experimental stimulus?

Decisions:

To judge effect of pretesting, compare:

✓ $O_2$-$O_3$ (experimental group with and without pretest)
✓ $O_4$-$O_6$ (control group with and without pretest)
Pre-experimental designs:
natural settings

1) One-shot case study: \( X \ O_1 \)
2) Pretest-posttest design: \( O_1 \ X \ O_2 \)
3) Posttest-comparison group design
   (Schutt: ex post factor control group design)

\[
\begin{array}{c}
X \\
\hline
O_c
\end{array}
\]

Contrasted groups design
(Schutt: nonequivalent control groups)

Figure A: Reading scores by grade

![Figure A: Reading scores by grade](image)
Contrasted groups design
(Schutt: nonequivalent control groups)

Figure B: Reading scores by grade

Time-series design

O1  O2  O3  X  O4  O5  O6

- Multiple observations over time
- Example: Connecticut crackdown on speeding (1955)
Time-series design

Figure B: Number of fatalities, CT., 1951-59

Control-series design
(Schutt: multiple group before-and-after design)

Fatality Rates, 1951-59